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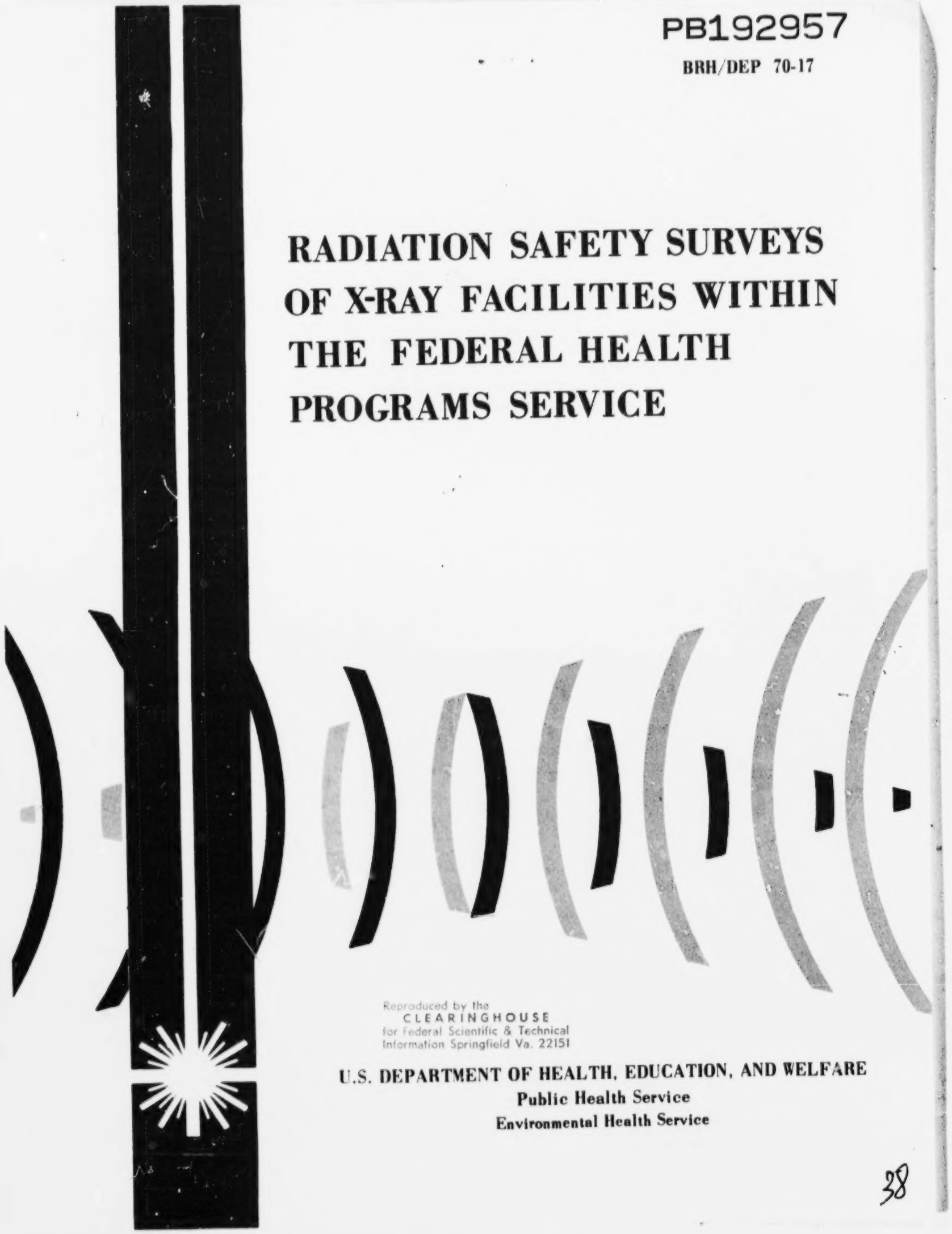
BRH/DEP 70-17

RADIATION SAFETY SURVEYS OF X-RAY FACILITIES WITHIN THE FEDERAL HEALTH PROGRAMS SERVICE



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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service

38

BRH/DEP 70-17

RADIATION SAFETY SURVEYS OF X-RAY FACILITIES WITHIN THE FEDERAL HEALTH PROGRAMS SERVICE

Conducted

March 1968 - February 1969

Lois A. Miller and LaVert C. Seabron

Intelligence Branch
Division of Electronic Products

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service
Bureau of Radiological Health
Rockville, Maryland 20852

FOREWORD

The Bureau of Radiological Health, formerly the National Center for Radiological Health, continues to carry out a national program designed to reduce the exposure of man to hazardous ionizing and non-ionizing radiation.

Within the Bureau, the Division of Electronic Products (1) develops and administers performance standards for radiation emissions from electronic products, (2) studies and evaluates emissions of and conditions of exposure to electronic product radiation and intense magnetic fields, (3) conducts or supports research, training, development, and inspections to control and minimize such hazards, and (4) tests and evaluates the effectiveness of procedures and techniques for minimizing such exposures.

The Bureau publishes its findings in Radiological Health Data and Reports (a monthly publication), Public Health Service numbered reports, appropriate scientific journals, and technical report series for the Bureau's divisions, offices, and laboratories.

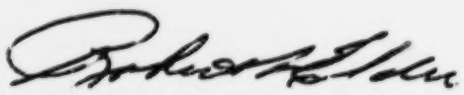
The technical reports of the Division of Electronic Products (DEP) allow comprehensive and rapid publishing of the results of intramural and contractor projects. The reports are distributed to State and local radiological health program personnel, Bureau technical staff, Bureau advisory committee members, university radiation safety officers, libraries and information services, industry, hospitals, laboratories, schools, the press, and other interested individuals. These reports are also included in the collections of the Library of Congress and the Clearinghouse for Federal Scientific and Technical Information.

I encourage the readers of these reports to inform the Bureau of any omissions or errors. Your additional comments or requests for further information are also solicited.

John C. Villforth
Director
Bureau of Radiological Health

PREFACE

Part of the mission of the Bureau of Radiological Health (formerly the National Center for Radiological Health) is to develop and operate a comprehensive radiological health program. In keeping with this mission, a program of radiation safety was developed for the Division of Direct Health Services (now Federal Health Program Services). This report describes the first comprehensive survey of the x-ray facilities in Public Health Service hospitals and outpatient clinics throughout the United States. Included are analyses of facility workloads, type of equipment, operator training, and equipment deficiencies, with recommendations for improving radiation protection for operators and patients.



Robert L. Elder, Sc.D.
Acting Director
Division of Electronic Products

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ABSTRACT

A comprehensive survey was performed between March 1968 and February 1969 of the x-ray facilities in 11 Public Health Service hospitals and 20 outpatient clinics throughout the United States. Facility workloads, type of equipment, operator training, and equipment deficiencies were analyzed, and recommendations were made for improved training programs, equipment modifications, and continuing facility surveys at regular intervals.

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RADIATION SAFETY SURVEYS OF X-RAY FACILITIES WITHIN THE FEDERAL HEALTH PROGRAMS SERVICE

INTRODUCTION

In February 1967 representatives of the Federal Health Programs Service (formerly the Division of Direct Health Services) and the Bureau of Radiological Health (BRH) met to discuss radiation safety within the Public Health Service and specifically within the Federal Health Programs Service (FHPS). It was recommended that BRH (1) assist FHPS in developing radiation standards, (2) make a thorough radiological evaluation of all FHPS facilities, and (3) assist FHPS in establishing better specifications for new x-ray equipment.

As a result of this meeting and subsequent contacts, a survey plan for the evaluation of x-ray facilities within FHPS was instituted. The radiation safety survey of a facility was performed upon request from the medical officer-in-charge of each facility.

In December 1967 a meeting was held to discuss an agreement by which BRH would perform a radiation safety survey of all FHPS facilities. Subsequent meetings were held with the Safety Officer of FHPS to define the scope and cost of the program, the protocol to be followed in contacting the individual institutions, and the working of a Memorandum of Agreement between FHPS and BRH which would formally provide for the implementation of a facility safety survey program.

The objectives of the facility radiation safety survey program developed for FHPS were:

1. To initiate and conduct a survey of all FHPS x-ray installations within a period of one year. Each survey was to include a complete radiological health and safety evaluation as it applied to the safety of patients, operating personnel, and occupants of adjacent areas.

2. To recommend modifications or changes in equipment and operating procedures which, when implemented, would reduce patient and occupational exposures.

3. To administer a continuing program for FHPS-wide registration of all radiation sources to be implemented by BRH.

4. To develop a system whereby all or selected facilities within FHPS would be resurveyed every two years.

5. To promote interest in the principles of radiation protection among FHPS personnel responsible for the operation of x-ray equipment.

By mid-December 1967, all parties concerned had agreed to the terms of the proposal, and the Memorandum of Agreement was signed. The contract initiation date was set for January 1, 1968, and the installation surveys were to begin March 1, 1968 (see appendix A).

PROCEDURE

The procedure followed in carrying out the terms of the Memorandum of Agreement consisted of two phases. These were: (1) preliminary activities involving forms design, budget preparation, and survey scheduling; and (2) the actual survey activity.

PRELIMINARY ACTIVITY

Data provided by the Federal Health Programs Service indicated that of their 31 installations located in 21 States, including Washington, D.C., 11 were hospitals and 20 were outpatient clinics (fig.1). Based on this information, an estimated project budget was prepared which included personnel cost, travel related expenses, and film badge service at each installation for one year.

To provide for the transfer of funds that would be necessary to finance the survey program, the Bureau of Radiological Health submitted Form 1081; "Voucher and Schedule of Withdrawals and Credits", to FHPS (see appendix B).

Also, to ensure that each facility would be surveyed within the time period allotted and at the cost specified in the Memorandum of Agreement, a master facility survey schedule was prepared. The schedule grouped installations by geographic area so that all facilities could be covered in six extended trips. Each trip was designed for a single surveyor, with the projected schedule requiring a total of 43 man-days for completion. Once the master facility survey schedule was approved, the chief medical officer at each facility was contacted by mail to confirm the date(s) for the survey and number of x-ray machines at the facility.

Table 1 provides a comparison between estimated and actual program costs.

Figure 1. Federal Health Programs Service facilities.

Table 1. Project budget data (estimated versus actual).

	Estimated	Actual
Number of facilities	33	31
Number of Units	141	148
Medical units	102	104
Dental units	39	44
Man-days required to complete survey	43	42 3/4
Cost of survey activity	$3,853.70	$4,232.03
Cost of film badge service	400.00	400.00
Total cost of project	4,253.70	4,632.03
Cost per facility	128.90	149.42
Cost per unit	30.17	31.30

Additional consultation between FHPS and BRH personnel resulted in agreement that the standards as set forth in NCRP Report No. 33, "Medical X-ray and Gamma-Ray Protection for Energies up to 10 MeV," and National Bureau of Standards Handbook 76, "Medical X-ray Protection up to Three Million Volts," would be used as guides for the survey and compliance purposes of the project. The data would be collected on forms: PHS 4495-1, "X-ray Protection Survey Report--Facility;" PHS 4495-3 "X-ray Protection Survey Report--Radiographic;" PHS 4495-2, "X-ray Protection Survey Report--Fluoroscopic;" PHS 4495-7, "Radiation Protection Survey Report--Therapeutic;" and "X-ray Protection Survey Report--Dental" (a new form which was field tested for the first time in this project). Use of a specially designed registration of radiation sources form was also agreed upon (see appendixes C, D, E, F, and G).

SURVEY ACTIVITY

The survey program officially began on April 17, 1968. Procedures followed by the surveyor were identical for each installation to allow for comparison of data at the conclusion of the survey program.

The equipment used by the surveyor consisted of a Victoreen Condenser-R-Meter including the charger-reader and ionization chambers in the ranges of 0-10 and 0-25 Roentgens full scale, an ionization chamber rate meter, spinning top, fluorescent strips for beam size determinations, steel tape measurer, and assorted filters and collimators.

At each facility the x-ray equipment was registered on the Radiation Source Registration Form (see appendix H), and an equipment identification decal imprinted with a registration number was affixed to the control panel of each machine. Then the machine was surveyed for compliance with the guides previously agreed upon and the data collected on the appropriate forms. An evaluation was then made of the physical plant itself, including an examination of the traffic patterns within the X-ray Department, the shielding incorporated in the walls of the treatment room, and the proximity of the tube to adjacent occupied areas. A check was made of the darkroom facility to ensure that it was lighttight, that a thermometer was present, that a proper safelight was in use, and that the time-temperature method of development was actually being followed.

During the course of the survey, the operator of the equipment was questioned about the procedures and techniques he employed in the conduct of his duties and also about the training he had received since assuming his duties.

Upon completion of the survey, the medical officer-in-charge or his designated representative was advised by the surveyor of any deficiencies noted during the survey. A comprehensive written report covering the survey was later submitted to the facility, with a copy also going to the project officer for FHPS.

SURVEY FINDINGS

Following the completion of the survey program, the data were analyzed by the Center and the findings summarized.

FACILITY INFORMATION

Table 2 summarizes the personnel, equipment, and machine workloads of the x-ray facilities surveyed. As can be seen from these data, in general each facility surveyed consisted of one dental x-ray machine, and three medical x-ray machines. Of the 1,049,464 exposures per year, 731,172 or 69.6 percent are reported by hospitals. The estimated number of patients per year reported by the hospitals is 257,608.

DEFICIENCIES IN RADIOGRAPHIC MACHINES

Table 3 presents the deficiencies noted on the diagnostic radiographic units surveyed. (Eight units were in storage or not used).

For 1.9 percent of the medical machines surveyed, the total filtration in the useful beam was found to be less than that required on the basis of the maximum tube potential. Total filtration was adequate on all dental units. In each instance where this deficiency was noted, sufficient additional aluminum filtration was added to bring the total up to the value required by the maximum tube potential.

Inadequate collimation of the useful beam, in that the dimensions of the primary beam exceeded the dimensions of the film size, was found on 4.4 percent of the medical x-ray machines surveyed.

Although 63 percent of the medical x-ray machines surveyed were equipped with a variable collimator which gave a visible indication of beam size, many of the operators of the machines did not know how to correctly use the collimator; therefore, its value in reducing unnecessary radiation exposure was negated.

Table 2. Facility information.

Personnel	Not determined	Number of facilities reporting	Number	Average/ facility
No. of personnel occupationally exposed	4	27	239	8.9
No. of personnel monitors	7	24	282	11.7
No. of X-ray machine operators	3	28	210	7.5
No. of operators per machine			1.4	6.7
Equipment				
Total no. of x-ray machines		31	148	4.8
No. of dental x-ray machines		31	44	1.4
No. of medical x-ray machines		31	104	3.3
Fixed radiographic		31	35	1.1
Radiographic-fluoroscopic		31	41	1.3
Mobile		31	22	.7
Photofluorographic		31	2	.06
Therapy		31	4	.1
Workload				
No. of patients radiographed/yr		31	369,184	11,909.0
Medical		31	37,664	1,214.9
Dental				
No. of exposures (film)/yr		31	907,648	29,278.9
Medical		31	140,816	4,542.4
Dental				
No. of patients fluoroscoped/yr	5	26	19,968	768.0
No. of therapy treatments/yr		1	6,812	
Radiographic workload (mA/min/yr)		30	127,903.2	4,263.4
Medical	1	27	27,476.8	1,017.6
Dental	4			

Table 3. Deficiencies noted on diagnostic radiographic machines.

Deficiency	Number	Percent of machines surveyed
Total filtration required correction to meet appropriate standards (medical)	2	1.9
Excessive beam size (medical)	3	2.2
Improper cone used, proper cone not available, variable collimator recommended (medical)	3	2.2
Variable collimator not functioning properly	4	2.9
No collimator or cones available	2	1.5
Beam diameter at cone tip exceeded three inches (dental)	0	0
Timer inaccurate and/or nonreproducible		
Medical	11	10.5
Dental	14	31.8
Unsatisfactory operator protection (medical)	5	4.8
Exposure control switch cord inadequate (mobile)	16	75.0

X-ray machine timer accuracy and/or reproducibility proved to be deficient in 10.5 percent of the medical x-ray units and 31.8 of the dental x-ray units. To be considered accurate, the timer should deliver exactly the exposure time to which it has been set. Reproducibility is the ability to give the same exposure time in successive tests in which the timer setting remains the same. Of the two, reproducibility is the most important from the standpoint of reducing unnecessary radiation exposure. By adjusting the timer setting, the operator can compensate for a timer that is known or suspected to be inaccurate, provided the exposure time is consistent in succeeding exposures. A timer that has poor reproducibility makes it almost impossible for the operator to compensate for this defect because of the variation in exposure time. Thus, the patient may receive unnecessary exposure from retakes necessitated by the unacceptable films produced as a result of the faulty timer.

Operator and patient protection was found to be adequate at most fixed machine installations. In general, a lead-lined shield or booth was provided for the operator, and there was sufficient shielding to protect persons outside of the x-ray room from scattered radiation. However, on 75 percent of the mobile x-ray machines the exposure switch cord length was such that it was not possible for the operator to stand at least 6 feet from the patient, the x-ray tube, and the useful beam. In each instance where operator protection was found to be inadequate, recommendations have been made which, when implemented, will correct the condition.

DEFICIENCIES ON FLUOROSCOPES

Table 4 lists the deficiencies noted on the fluoroscopes surveyed. (Four of the 41 fluoroscopes were not used.)

The major deficiencies observed were the absence of Bucky-slot covers, failure of the diaphragm system to restrict the x-ray beam to the area of the viewing screen, and the absence of a protective drape between the patient and fluoroscopist to intercept scattered radiation. The high incidence of these three deficiencies may be used as an index of the age of the x-ray machines surveyed inasmuch as they are likely to be found on fluoroscopes manufactured prior to 1960. On machines manufactured after that date these appurtenances appear as standard equipment.

Table 4. Deficiencies noted on fluoroscopic units.

Deficiency	Number	Percent of machines surveyed
Leaded protective gloves not available or not used	1	2.7
Protective cover for Bucky-slot absent	7	18.9
Diaphragm system permits x-ray beam to exceed area of viewing screen	4	10.8
Manually reset cumulative timer to indicate elapsed time absent	2	5.4
Protective drape between patient and fluoroscopist to intercept scattered radiation absent	10	27.0
Excessive transmission of x-ray beam through viewing screen	1	2.7
Total filtration in useful beam less than 2.5 mm aluminum equivalent	1	2.7
Dose rate at panel top greater than 3.2 R/mA-min	0	0

In only one of the machines surveyed was the total filtration in the primary beam less than 2.5 mm aluminum equivalent. The dose rate at the panel top of all fluoroscopes surveyed was found to be equal to or less than 3.2 R/mA-min. There was one instance of excessive transmission of the x-ray beam through the viewing screen. As in the case of those radiographic machines on which deficiencies were noted, recommendations for the correction of deficiencies have been made.

DEFICIENCIES IN THERAPY MACHINES

Only four therapy machines were surveyed, and no deficiencies were found.

OPERATOR TRAINING

One of the most important deficiencies observed during the surveys was that of operator training. It was noted that this problem occurred primarily in smaller installations where a medical technician was required to double as an x-ray technician with little or no formal training. On the other hand, the large installations quite often had an overabundance of trained x-ray technicians who could be used elsewhere.

RECOMMENDATIONS

An analysis of the data collected reveals that the major problem areas are inadequate training of x-ray machine operators and the modification of existing equipment so that it meets currently acceptable standards. In view of these facts, the following recommendations are made:

1. That a short radiological technologist training program be instituted for new x-ray personnel and existing personnel who have had little or no formal training. Repetition of this course will provide the Federal Health Programs Service with a steady supply of x-ray machine operators with some knowledge of radiation protection.

2. That the modifications or changes in equipment and operating procedures recommended by the surveyors be implemented.

3. That the facility radiation safety survey program be continued with facilities being surveyed at the following frequencies:

   a. Annually - Public Health Service Hospitals at Baltimore, Md.; Bostin, Mass.; New Orleans, La.; Norfolk, Va.; Staten Island, N.Y.; and Galveston, Tex.

   b. Every two years - Public Health Service Hospitals at Carville, La.; San Francisco, Calif.; and Seattle, Wash.; Public Health Service Outpatient Clinics at Atlanta, Ga.; Buffalo, N.Y.; Charleston, S.C.; Chicago, Ill.; Memphis, Tenn.; Miami, Fla.; Mobile, Ala.; New York, N.Y.; Philadelphia, Pa.; Portland, Ore.; Portland, Me.; St. Louis, Mo.; San Diego, Calif.; Savannah, Ga.; Tampa, Fla.; and Washington, D.C.

APPENDIX A

MEMORANDUM OF AGREEMENT

Between
Division of Direct Health Services
Bureau of Health Services

and

Bureau of Radiological Health

for

Facility Radiation Safety Surveys

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I. PURPOSE:

To develop, through Interbureau cooperation, an organized, coordinated radiological health survey program within the Division of Direct Health Services, Environmental and Biomedical Engineering Branch.

II. CONTRACTOR'S NAME:

National Center for Radiological Health
Medical and Occupational Radiation Program
X-ray Section

III. SPONSOR'S NAME:

Division of Direct Health Services
Environmental Health and Biomedical Engineering Branch

IV. DESCRIPTION OF WORK:

A. Objective

1) Initiate and conduct a survey of all X-ray installations within one year. Each survey will include a complete Radiological Health and Safety evaluation as it applies to the safety of patients, operating personnel and occupants of adjacent areas.

2) To recommend modifications or changes in equipment and operating procedures which when implemented will reduce patient and occupational exposures.

3) To administer a Division-wide registration of radiation sources program.

4) To develop a system whereby all or selected facilities within the Division will be resurveyed every two years.

5) To promote interest in the principles of radiation protection among Division personnel responsible for the operation of X-ray equipment.

B. Procedure

1) All arrangements for conducting surveys inclusive of scheduling, travel and quarters will be handled by the National Center for Radiological Health.

2) The National Center for Radiological Health agrees to supply the Division of Direct Health Services' 350 film badges during the period covered by this agreement and survey all Division of Direct Health Services' x-ray facilities operating within the Continental United States, as of the date this agreement is signed. The National Center for Radiological Health will contact each institution.

3) The contractor will provide the sponsor with a tentative timetable of facility visitations within thirty (30) days after the signing of this agreement, so that the necessary clearances can be made.

4) The sponsor will provide the contractor with letters of clearance, or their equivalent, for project personnel to be named by the contractor.

5) The sponsor will provide, at each facility, one (1) person who will operate the x-ray equipment and be available to assist the surveyor.

V. STANDARDS OR GUIDES:

The standards as set forth in NBS Handbook 76, "Medical X-ray Protestion Up to Three Million Volts," or an adopted revision thereof, shall be the guide for the survey and compliance purposes of x-ray equipment.

VI. COST TO THE GOVERNMENT:

The maximum cost to the Division of Direct Health Services, Bureau of Health Services, shall be $4,500, including film badge service. Transfer of funds will be made utilizing Form 1081. One Form 1081 will be processed prior to June 30, 1968. Another Form 1081 will be processed prior to February 28, 1969.

VII. PERIOD OF SERVICE:

The initiation date of this contract will be March 1, 1968; and closing date, February 28, 1969.

VIII. PROJECT DIRECTOR:

LaVert C. Seabron, Radiation Specialist
X-ray Section
Medical and Occupational Radiation Program
National Center for Radiological Health

IX. PROJECT OFFICER:

Truman McCasland
Division of Direct Health Services
Environmental and Biomedical Engineering Branch

X. REPORTS:

Upon completion of the radiological health survey of each facility, the contractor shall prepare a written "Radiological Health Survey Report". which will contain the findings and recommendations of the contractor.

The distribution of the Radiological Health Survey report shall be as follows:

1) Two copies -- Environmental Health and Biomedical Engineering Branch Project Officer
2) Two copies -- Medical Officer in charge of facility
3) One copy -- National Center for Radiological Health Regional Representative of the Region in which the facility is located.
4) One copy -- National Center for Radiological Health files.

APPROVED:

signed	signed
Robert R. Harwick Executive Officer National Center for Radiological Health	John J. Walsh, M.D. Assistant Surgeon General Director, Division of Direct Health Services
	2/28/68
	Date

APPENDIX B

VOUCHER AND SCHEDULE OF WITHDRAWALS AND CREDIT

STANDARD FORM 1081
2 TREASURY FRM 2500
FISCAL SERVICE
BUREAU OF ACCOUNTS
1081-107

VOUCHER AND SCHEDULE OF WITHDRAWALS AND CREDITS

29

Vou. No. _____
(Office billed)

Vou. No. _____
(Billing Office)

To Disbursing Officer—Office Billed

_____
(D.O. symbol)

You are authorized to effect the withdrawals and credits indicated below.

Disbursing Officer—Billing Office

_____
(D.O. symbol)

_____
(Address)

PAID BY

WITHDRAW FROM—	PAY TO—
DEPARTMENT	DEPARTMENT
BUREAU	BUREAU
AGENCY STATION SYMBOL	AGENCY STATION SYMBOL
ADDRESS	ADDRESS

BUREAU REFERENCE	SUMMARY	
	APPROPRIATION OR FUND SYMBOL	AMOUNT
	TOTAL	

BUREAU REFERENCE	SUMMARY	
	APPROPRIATION OR FUND SYMBOL	AMOUNT
	TOTAL	

Details of charges or reference to attached supporting documents

For use of office billed:	For use of billing office:

CERTIFICATE OF OFFICE BILLED

I certify that the items listed herein are correct and proper for payment from the appropriation(s) designated.

_____
(Date)

_____
(Authorized administrative or certifying officer)

Paid by check No. _____ C/D No. _____, dated _____

* U.S. GOVERNMENT PRINTING OFFICE : 1968 — 312 - 321

APPENDIX C

FACILITY SURVEY FORM

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

X-RAY PROTECTION SURVEY REPORT
FACILITY

FORM APPROVED
BUDGET BUREAU NO. 68-R905

1. NAME OF FACILITY

2. TELEPHONE

3. NUMBER ASSIGNED BY AGENCY (1 2 3 4 5 6)

4. LOCATION *(Street, Building, Room Number)*

7. STATE | COUNTY | CITY | ZIP CODE

5. DATE *(Mo., Day, Yr.)* (7 8 9 10 11 12)

6. CARD I.D. 1 (13 14 15 16 17) (18 19) (20 21 22) (23 24 25 26)

8. PERSON IN CHARGE OF X-RAY FACILITY

9. PERSON RESPONSIBLE FOR RADIATION SAFETY: NAME TITLE

10. PERSON INTERVIEWED: POSITION

11. PREVIOUS RADIATION SAFETY SURVEY: 1. ___ Yes 2. ___ No (27)

BY WHOM: DATE:

12. TYPE OF FACILITY: 1. ___ Private Office 2. ___ Hospital 3. ___ Clinic (28)
4. ___ Mobile 5. ___ Other *(Specify)*

13. TYPE OF PRACTICE: (29 30)

PERSONNEL

14.

A. TOTAL NUMBER OCCUPATIONALLY EXPOSED _____ A (31 32)

B. TOTAL NUMBER OF OPERATORS _____ (33 34) C. TOTAL NUMBER MONITORED _____ C (35 36)

D. MONITORING SYSTEM EMPLOYED: 0. ___ Never or none 1. ___ Currently 2. ___ Within past year 3. ___ Not within past year (37)

E. MONITORING SYSTEM ADEQUATE: 1. ___ Yes 2. ___ No 3. ___ N/A (38)

F. MONITORING RECORDS SATISFACTORY: 1. ___ Yes 2. ___ No 3. ___ N/A (39)

G. LEVELS/MONTH: _____ Maximum MR. H. NUMBER OVER 300 MR QUARTER _____ H (40)

"WORKLOAD"

15.

A. PATIENTS RADIOGRAPHED *(Average per week)* _____ A (41 42 43 44)

B. PATIENTS FLUOROSCOPED *(Average per week)* _____ B (45 46 47)

C. THERAPY TREATMENTS *(Average per week)* _____ C (48 49 50)

EQUIPMENT

16.

A. TOTAL NUMBER OF MACHINES AT THIS FACILITY _____ A (51 52)

B. TOTAL NUMBER OF UNITS *(Tubes)* _____ B (53 54)

FILM AND SCREEN

17

A. BRAND AND TYPE OF X-RAY FILM USED _____ A (55 56)

B. TYPE OF INTENSIFYING SCREEN _____ B (57 58)

DARKROOM PROCEDURE

A. DARKROOM LIGHT TIGHT: 0. ___ No darkroom 1. ___ Yes 2. ___ No A (59)

B. TYPE OF DEVELOPER: _____ B (60 61)

C. AUTOMATIC PROCESS: 1. ___ Yes 2. ___ No C (62)

D. HOW OFTEN CHANGED *(Weeks)* _____ (63 64) E. HOW OFTEN REPLENISHED *(Days)* _____ E (65 66)

F. THERMOMETER PRESENT: 1. ___ Yes 2. ___ No 3. ___ Thermostatically controlled F (67)

G. TEMPERATURE INDICATED: _____ °F (68 69) H. TIMER PRESENT: 1. ___ Yes 2. ___ No (70)

I. TIME IN DEVELOPER *(Minutes)* _____ I (71 72)

RADIOACTIVE MATERIALS

19.

A. RADIUM EVER PRESENT: 1. ___ Yes 2. ___ No A (73)

B. OTHER ISOTOPES EVER PRESENT: 1. ___ Yes 2. ___ No B (74)

REASON FOR SURVEY

20

1. _____ Initial 2. _____ Follow-up 3. _____ Re-survey
4. _____ Request 5 _____ Complaint 6. _____ Other *(Specify)* (78)

SURVEYORS

21

A. _____ B. _____

PHS-4495-1 (REV. 10-67)

(Use reverse side for remarks or sketch)

WORKLOAD *(Ma-Min/wk)* _____ **SHIELDING INFORMATION** MAX. KVP _____

LOCATION	COMPOSITION AND THICKNESS	ENVIRONS OR CONTROL	PRIMARY OR SECONDARY	USE X OCCUPANCY	TARGET TO WALL DISTANCE	N.B.S. REQUIRED BARRIER	ADDITIONAL SHIELDING REQUIRED
NORTH *(Top)*							
EAST *(Right)*							
SOUTH *(Bot.)*							
WEST *(Left)*							
ABOVE							
BELOW							

SKETCH OF FACILITY AND/OR REMARKS

(Indicate scale used)

APPENDIX D

RADIOGRAPHIC SURVEY FORM

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

X-RAY PROTECTION SURVEY REPORT
RADIOGRAPHIC

FORM APPROVED
BUDGET BUREAU NO. 68-R908

1. NAME OF FACILITY | 2. TELEPHONE | 3. NUMBER ASSIGNED BY AGENCY (1 2 3 4 5 6)

4. LOCATION (Street, Building, Room Number) | 7. STATE | COUNTY | CITY

5. DATE (Mo., Day, Yr.) (7 8 9 10 11 12) | 6. CARD I.D. 2 (13 14 15 16 17) | (18 19) | (20 21 22) | (23 24 25 26)

8. EQUIPMENT IDENTIFICATION

A. NUMBER ASSIGNED MACHINE _____

B. CONTROL PANEL MANUFACTURER _____ B (27 28)

C. TUBE HEAD MANUFACTURER AND MODEL _____ C (29 30)

D. COMBINATION: 1. ___ Yes 2. ___ No D (31)

E. TYPE: 1. ___ Fixed Radiographic (indicate special type) _____
2. ___ Photofluorographic 3. ___ Mobile 4. ___ Other (specify) _____ E (32)

F. NUMBER OF TUBES (33)

G. MAXIMUM KVP (RATED) (34 35 36)

H. MAXIMUM MA (RATED) (37 38 39)

9. FILTRATION

A. TOTAL MM. ALUMINUM EQUIVALENT A. BEFORE (40 41) B. AFTER (42 43)

10. "WORKLOAD"

A. AVERAGE NUMBER OF PATIENTS PER WEEK (estimate) _____ A (44 45 46)

B. TOTAL NUMBER OF EXPOSURES PER WEEK (estimate) _____

11. USUAL PROCEDURES

	EXAMINATION (specify)	KVP	MA / TIME	MAS	EXPOSURES PER WK.	FILM SIZE	DISTANCE (inches)	BEAM TYPE	BEAM SIZE (inches)	COLLIMATION
1.	(47)	(48 49 50)		(51 52 53)		(54)	(55 56)	(57)	(58 59)	(60)
2.	(61)	(62 63 64)		(65 66 67)		(68)	(69 70)	(71)	(72 73)	(74)
3.										

12. EXPOSURE SWITCH

A. ADEQUATE LOCATION: 1. ___ Yes 2. ___ No A (75)

13. TIMER

A. ADEQUATE: 1. ___ Yes 2. ___ No A (76)

14. PROTECTIVE DEVICES

A. GONADAL SHIELD FOR PATIENT: 1. ___ Yes 2. ___ No 3. ___ N/A A (77)

B. ADEQUATE OPERATOR PROTECTION: 1. ___ Yes 2. ___ No B (78)

C. ADEQUATE PRIMARY AND SECONDARY BARRIERS: 1. ___ Yes 2. ___ No 3. ___ N/A C (79)

D. DIAGNOSTIC-TYPE TUBE HOUSING: 1. ___ Yes 2. ___ No D (80)

15. STRAY RADIATION MEASUREMENTS

POSITION	EXPOSURE RATE MR/HR	POSITION	EXPOSURE RATE MR/HR
A. OPERATOR		D.	
B.		E.	
C.		F.	

(MAXIMUM READINGS TAKEN AT KVP _____ MA _____ SECONDS _____)

16. SURVEYORS A. _____ B. _____

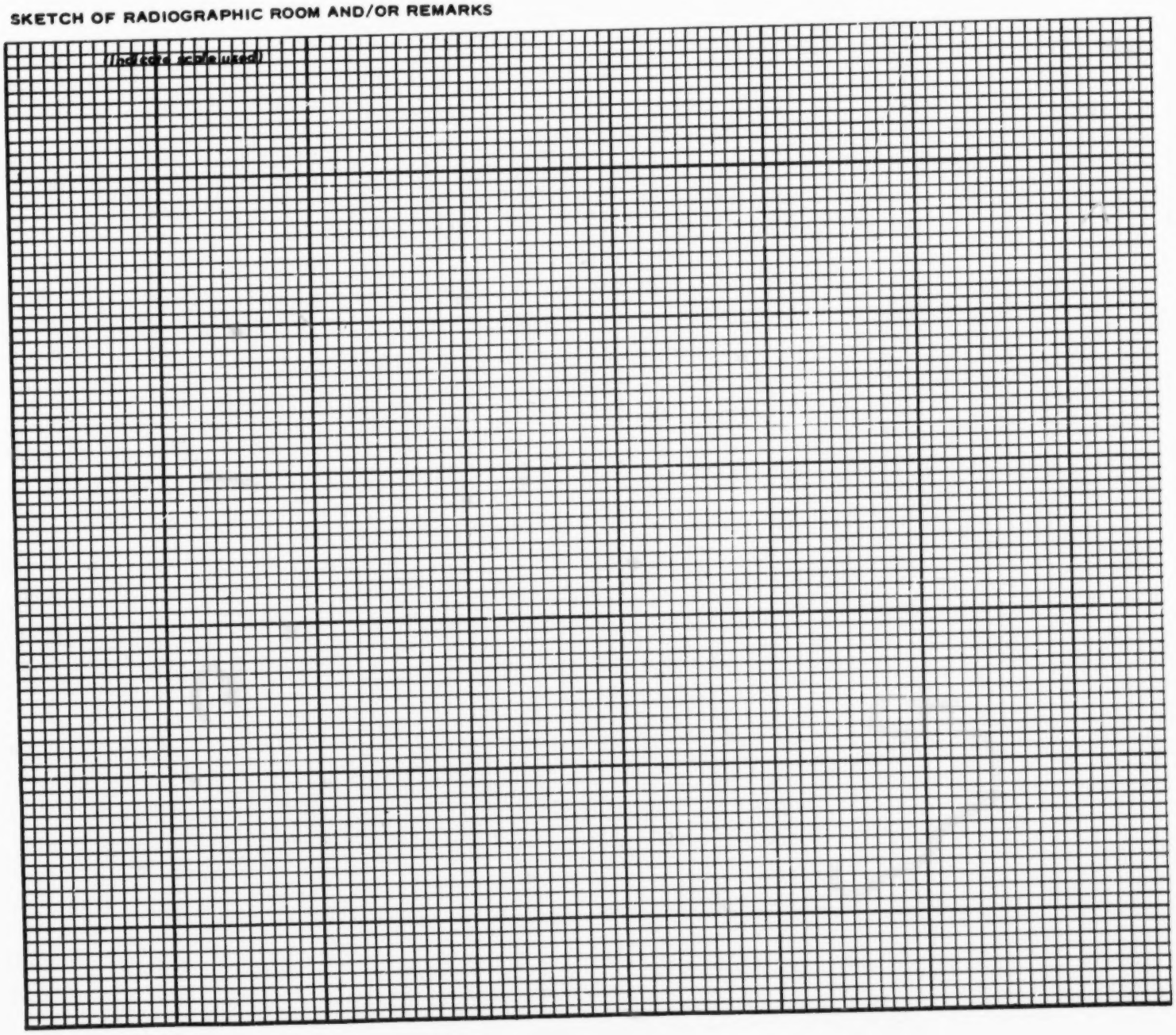
PHS-4495-3 (REV 7-65) *(Use reverse side for remarks or sketch)*

WORKLOAD *(Ma-Min/wk)* _____ **SHIELDING INFORMATION** MAX. KVP _____

LOCATION	COMPOSITION AND THICKNESS	ENVIRONS OR CONTROL	PRIMARY OR SECONDARY	USE X OCCUPANCY	TARGET TO WALL DISTANCE	N.B.S. REQUIRED BARRIER	ADDITIONAL SHIELDING REQUIRED
NORTH *(Top)*							
EAST *(Right)*							
SOUTH *(Bot.)*							
WEST *(Left)*							
ABOVE							
BELOW							

SKETCH OF RADIOGRAPHIC ROOM AND/OR REMARKS

(Indicate scale used)



PHS-4495-3 (BACK)
REV. 7-65

APPENDIX E

FLUOROSCOPIC SURVEY FORM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

X-RAY PROTECTION SURVEY REPORT
FLUOROSCOPIC

FORM APPROVED
BUDGET BUREAU NO. 68-R90+

1. NAME OF FACILITY | 2. TELEPHONE | 3. NUMBER ASSIGNED BY AGENCY (1 2 3 4 5 6)

4. LOCATION (Street, Building, Room Number) | 7. STATE | COUNTY | CITY | ZIP CODE

5. DATE (No., Day, Yr.) (7 8 9 10 11 12) | 6. CARD I.D. 3 (13 14 15 16 17) | (18 19) | (20 21 22) | (23 24 25 26)

8. EQUIPMENT IDENTIFICATION

A. NUMBER ASSIGNED MACHINE _____ B (27 28)
B. CONTROL PANEL MANUFACTURER _____ C (29 30)
C. TUBE HEAD MANUFACTURER AND MODEL _____
D. COMBINATION: 1. ___Yes 2. ___No — D (31)
E. TYPE: 1. ___Vertical 2. ___Horizontal 3. ___Tilting Table 4. ___Other — E (32)
F. IMAGE INTENSIFYING DEVICE USED: 1. ___Yes 2. ___No — F (33)
G. OTHER IDENTIFICATION (Specify)

9. ACCESSORY SHIELDING

A. LEADED GLOVES: 1. ___Yes 2. ___No (34) B. LEADED APRON: 1. ___Yes 2. ___No — B (35)
C. BUCKY SLOT COVER: 1. ___Yes 2. ___No 3. ___N/A — C (36)
D. LEADED DRAPES AROUND SCREEN: 1. ___Yes 2. ___No 3. ___N/A — D (37)
E. OTHER (Specify)

10. DARK ADAPTATION

A. GOGGLES USED: 1. ___Yes 2. ___No B. NUMBER OF MINUTES: _____ B (38 39)

11. USUAL PROCEDURES

EXAMINATION	KVP	MA	MINUTES TUBE ACTIVATED PER EXAMINATION	EXAMINATIONS PER WEEK
A. UPPER G. I.	(40 41 42)	(43 44)	(45)	(46 47)
B. LOWER G.I.	(48 49 50)	(51 52)	(53)	(54 55)
C. OTHER (Specify)				(56 57)

D. TOTAL MA-MIN/ WEEK (58 59 60)

12. SPOT FILMS

A. AVERAGE EXPOSURES PER WEEK: _____ (61 62 63)

13. SCREEN

A. FLUOROSCOPIC SCREEN GANGED TO X-RAY TUBE: 1. ___Yes 2. ___No — A (64)
B. LEADED GLASS SATISFACTORY: 1. ___Yes 2. ___No 3. ___N/A — B (65)
C. SHUTTERS FUNCTION PROPERLY: 1. ___Yes 2. ___No 3. ___Fixed — C (66)
D. USEFUL BEAM LIMITED TO SCREEN: 1. ___Yes 2. ___No — D (67)
Overlap: ___Top ___Right ___Bottom ___Left

14. DISTANCE

A. TARGET TO PANEL (inches): _____ A (68 69)

15. ROENTGEN OUTPUT

A. USEFUL BEAM AT PANEL SURFACE: _____ R/MIN. A (70 71 72)

16. FILTRATION

A. TOTAL MM. ALUMINUM EQUIVALENT: A. Before (73 74) B. After (75 76)

17. TIMER

A. DEADMAN TYPE EXPOSURE SWITCH: 1. ___Yes 2. ___No
B. MANUALLY RESET CUMULATIVE TIMER: 1. ___Yes 2. ___No
C. CUMULATIVE TIMER TERMINATES EXPOSURE: 1. ___Yes 2. ___No
A (77) B (78) C (79)

18. FLUCROSCOPIC ROOM

A. LIGHT TIGHT: 1. ___Yes 2. ___No 3. ___N/A — A (80)

19. STRAY RADIATION MEASUREMENTS

POSITION	EXPOSURE RATE (MR/HR)	POSITION	EXPOSURE RATE (MR/HR)
A. OPERATOR		D.	
B. ABOVE SCREEN		E.	
C.		F.	

(MAXIMUM READINGS TAKEN AT KVP_____ MA _____ SECONDS _____)

20. SURVEYORS

A. _____ B. _____

PHS-4495-2 (REV. 10-67) *(Use reverse side for remarks or sketch)*

WORKLOAD *(Ma-Min/wk)* _____ **SHIELDING INFORMATION** MAX. KVP _____

LOCATION	COMPOSITION AND THICKNESS	ENVIRONS OR CONTROL	PRIMARY OR SECONDARY	USE X OCCUPANCY	TARGET TO WALL DISTANCE	N.B.S. REQUIRED BARRIER	ADDITIONAL SHIELDING REQUIRED
NORTH *(Top)*							
EAST *(Right)*							
SOUTH *(Bot.)*							
WEST *(Left)*							
ABOVE							
BELOW							

SKETCH OF FLUOROSCOPIC ROOM AND/OR REMARKS

(Indicate scale used)

APPENDIX F

THERAPEUTIC SURVEY FORM

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

RADIATION PROTECTION SURVEY REPORT
THERAPEUTIC

FORM APPROVED
BUDGET BUREAU NO. 68-R008

1. NAME OF FACILITY | 2. TELEPHONE | 3. NUMBER ASSIGNED BY AGENCY (1 2 3 4 5 6)

4. LOCATION (Street, Building, Room Number) | 7. STATE | COUNTY | CITY | ZIP CODE

5. DATE (Mo., Day, Yr.) (7 8 9 10 11 12) | 6. CARD I.D. 4 (13 14 15 16 17) | (18 19) | (20 21 22) | (23 24 25 26)

8. EQUIPMENT IDENTIFICATION

A. NUMBER ASSIGNED UNIT _____ B. RADIATION SOURCE _____ (27) C. UNIT MANUFACTURER: _____ (28 29)

D. TYPE OF UNIT: 1. ☐ Superficial 2. ☐ Deep 3. ☐ Supervoltage 4. ☐ Teletherapy 5. ☐ Other (Specify) _____ (30)

9. "WORKLOAD"

X-RAY

A. AVERAGE TIME PER TREATMENT (MIN.) _____ (31 32)

B. AVERAGE NUMBER OF TREATMENTS PER WEEK _____ (33 34 35)

C. MAXIMUM kVp USED _____ (36 37 38 39)

D. MAXIMUM mA USED _____ (40 41)

E. AVERAGE mAm PER WEEK _____ (42 43 44 45)

ISOTOPE

F. STRENGTH OF RADIONUCLIDE (RHM) _____ (46 47 48 49)

G. ROENTGENS PER WEEK AT ONE METER _____ (50 51 52 53)

10. FILTRATION

A. FILTER IDENTIFICATION SYSTEM 1. ☐ Yes 2. ☐ No 3. ☐ N/A — A (54)

B. SECURE FILTER SLOT 1. ☐ Yes 2. ☐ No 3. ☐ N/A — B (55)

11. COLLIMATION

A. SHUTTER POSITION INDICATED AT CONTROL 1. ☐ Yes 2. ☐ No 3. ☐ N/A — A (56)

B. VARIOUS PORT SIZES AVAILABLE 1. ☐ Yes 2. ☐ No 3. ☐ N/A — B (57)

C. LEAD RUBBER, FOIL, ETC., TO LIMIT FIELD 1. ☐ Yes 2. ☐ No 3. ☐ N/A — C (58)

12. PROTECTIVE QUALITIES AND DESCRIPTIVE INFORMATION

A. TYPE OF TREATMENT 1. ☐ Stationary 2. ☐ Rotational — A (59)

B. ADEQUATE INTERLOCK SYSTEM 1. ☐ Yes 2. ☐ No 3. ☐ N/A — B (60)

C. MANUALLY RESET CUMULATIVE TIMER 1. ☐ Yes 2. ☐ No 3. ☐ N/A — C (61)

D. TIMER TERMINATES EXPOSURE 1. ☐ Yes 2. ☐ No 3. ☐ N/A — D (62)

E. PATIENT AND CONTROL OBSERVED SIMULTANEOUSLY 1. ☐ Yes 2. ☐ No 3. ☐ N/A — E (63)

F. PATIENT-OPERATOR COMMUNICATION AVAILABLE 1. ☐ Yes 2. ☐ No 3. ☐ N/A — F (64)

G. RADIATION AREA POSTED 1. ☐ Yes 2. ☐ No 3. ☐ N/A — G (65)

H. PRIMARY BEAM SHIELD PRESENT 1. ☐ Yes 2. ☐ No 3. ☐ N/A — H (66)

I. CONTROL PANEL LOCKED WHEN NOT IN USE 1. ☐ Yes 2. ☐ No 3. ☐ N/A — I (67)

J. SOURCE CALIBRATED ANNUALLY 1. ☐ Yes 2. ☐ No 3. ☐ N/A — J (68)

DATE OF LAST CALIBRATION _____

K. THERAPEUTIC TYPE PROTECTIVE SOURCE HOUSING 1. ☐ Yes 2. ☐ No 3. ☐ N/A — K (69)

L. PRIMARY AND SECONDARY BARRIERS ADEQUATE 1. ☐ Yes 2. ☐ No 3. ☐ N/A — L (70)

M. ADEQUATE OPERATOR PROTECTION 1. ☐ Yes 2. ☐ No 3. ☐ N/A — M (71)

N. BEAM MONITORING DEVICE 1. ☐ Yes 2. ☐ No 3. ☐ N/A — N (72)

O. EMERGENCY PROCEDURES POSTED 1. ☐ Yes 2. ☐ No 3. ☐ N/A — O (73)

P. LEAK TEST PERFORMED 1. ☐ Yes 2. ☐ No 3. ☐ N/A — P (74)

DATE OF LAST TEST _____

13. SURVEYORS

A. _____ B. _____

PHS-4495-7 (REV. 2-67)

(Use reverse side for sketch and/or remarks)

RADIATION MEASUREMENTS

TAKEN AT _____ kV _____ FIELD SIZE _____ FILTER _____

LOCATION OF MEASUREMENTS	SKETCH POSITION	HEIGHT OF INSTRUMENT ABOVE FLOOR (IN FEET)	BEAM DIRECTION (IN DEGREES)	PHANTOM		mR/HOUR	REMARKS
				YES	NO		

15. SKETCH AND/OR REMARKS

16. SHIELDING INFORMATION

WORKLOAD (mAmin/wk) _____ MAX. kVp _____

LOCATION	COMPOSITION AND THICKNESS	ENVIRON OR CONTROL	PRIMARY OR SECONDARY	USE X OCCUPANCY	TARGET TO WALL DISTANCE	N.B.S. REQUIRED BARRIER	ADDITIONAL SHIELDING REQUIRED
NORTH (Top)							
EAST (Right)							
SOUTH (Bot.)							
WEST (Left)							
ABOVE							
BELOW							

PHS-4495-7 (BACK)
REV. 2-67

APPENDIX G

DENTAL SURVEY FORM

X-RAY PROTECTION SURVEY REPORT

DENTAL

1. Name of Facility	2. Telephone No.	3. Registration No.
4. Address (St., Bldg., Room No.)	5. State County City	
6. Date Mo., Day, Yr.	7. Card I.D.	8. Surveyor(s)

9. Type of Practice 1. General___ 2. Oral Surgery___ 3. Other ___

10. Equipment Identification
A. Manufacturer_____ B. Model _____
C. Console Serial No._____ D. Tube Serial No. _____
E. Maximum kVp (Rated _____ F. Maximum mA (Rated) _____

11. Pointer Cone 0. None _____ 2. Short Open _____ 4. Long Open _____ 6. Is pointer cone shielded? Yes ___ No ___
1. Short Pointed__ 3. Long Pointed _____ 5. Panoramic _____

12. Filtration (Total MM. Aluminum Equivalent)
Before _____After_____Filtration in compliance? Yes ___ No ___

13. Collimation (Field Diameter at End of Cone) (Inches)
Before _____ After _____ Collimation in Compliance? Yes ___ No ___

14. Workload A. Average Number of Patients Per Week _____ (estimate)
B. Total Number of Exposures Per Week _____ (estimate)

15. Usual Procedures (Describe) 1. Upper Molar 2. _____

	kVp	mA	Time	mAs

16. Estimated Occupational Exposure:
(Exposures/wk) (Calculated Ave. Exp. Time) (Ave. Exp.mr/hr) (0.015) = _____mr/yr

17. Exposure Mechanism:
A. Satisfactory Location Yes ___ No ___ If No, Specify _____
B. Timer Accurate Yes ___ No ___ (Refer to Item No. 21.)

18. Protective
A. Lead Apron for patients: Yes ____ No ____ Unk. ____
B. Satisfactory Operator Protection: Yes ____ No ____ Unk. ____
C. Satisfactory Primary Barriers: Yes ____ No ____ Unk. ____
D. Satisfactory Secondary Barriers: Yes ____ No ____ Unk. ____
E. Tube Housing Leakage: Yes ____ No ____ Unk. ____
F. Unit Grounded: Yes ____ No ____ Unk. ____
G. Use film holding devices: Yes ____ No ____ Unk. ____

19. Stray Radiation Measurements Reading at: kVp___mA___sec.__

Position	Exposure Rate in mr/hr	Position	Exposure Rate in mr/hr

20. Is the unit in compliance? Yes ____ No _____

21. Timer Accuracy:
A. Type of Timer _____ B. Range of Timer _____
C. Type of Rectification _____

TIMER SETTING	0.1 (1/10)sec.	0.25 (1/4)sec.	0.5 (1/2)sec.
Pulses:			

22. REMARKS: _____

ACCURACY: ± 5% at settings> 1.0 second
± 10% at settings< 1.0 second

APPENDIX H

REGISTRATION OF RADIATION SOURCES FORM

RADIATION SOURCE REGISTRATION FORM

1. Name of Facility _____

2. Location: _____

_____

3. Division: _____

4. Bureau: _____

5. Name & Title of Person to Contact For Further Information: _____

6. Type of Use or Practice: (Check appropriate blank)
   1. Medical _____
   2. Dental _____
   8. Research _____
   9. Other (Specify) _____

7. Type of Facility: (Check one)
   2. Hospital _____ 3. Clinic _____ 4. Mobile _____
   5. Educational Institution _____ 7. Other (Specify) _____

8. Type of Machine:
   A. 1. Single Radiographic _____
      2. Single Fluoroscopic _____
      3. R. & F. Combination _____
      4. Photofluorographic _____
      5. X-ray Therapy _____
      6. Dental X-ray _____

      Total Number of Tubes _____

   B. Manufacturer _____ Console Serial No. _____
      Model _____ Fixed _____ Portable _____

   C. Maximum: kVp _____ mA _____

9. Radioactive Materials: (If none at facility check here _____)
   A. Radium: 1. Yes _____ 2. No _____
      1. Number of Radium Sources _____
      2. Total Activity of Radium Sources _____(mg)
   B. No. of Teletherapy Apparatus _____
   C. Licensed Isotopes? 1. Yes _____ 2. No _____
   D. Other Non-licensed Isotopes? 1. Yes _____ 2. No _____

10. To the best of my knowledge, the above information is correct.

    Name (Type or Print) _____ Title _____

    Signature: _____ Date _____

REGISTRATION OF THIS SOURCE DOES NOT IMPLY APPROVAL OF THE EQUIPMENT OR ITS OPERATION

Registration No. _____

* U. S. GOVERNMENT PRINTING OFFICE : 1970— 436-612/3